

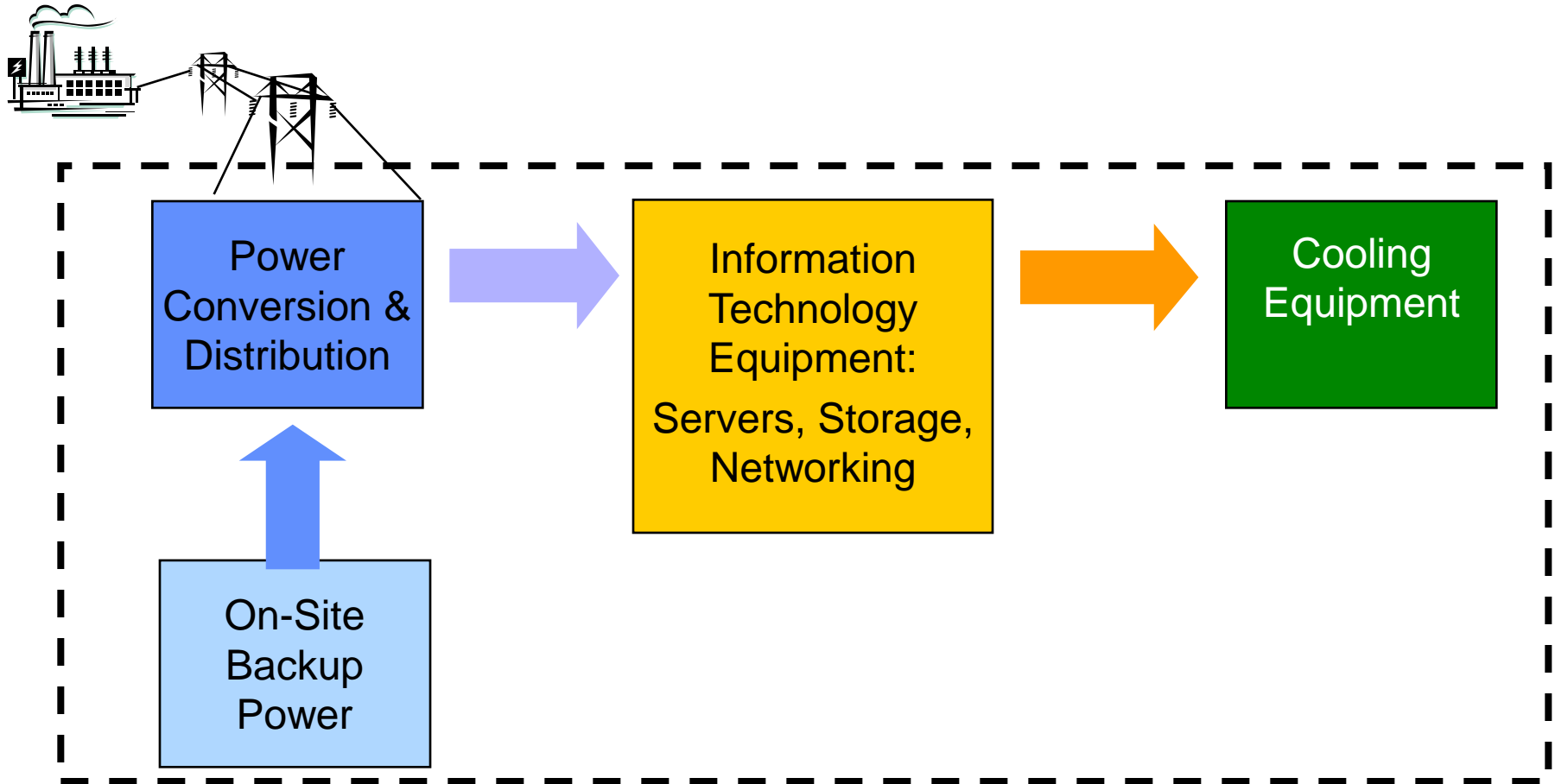


Federal Government Initiatives to Reduce Data Center Energy Use

Rich Brown

Lawrence Berkeley National Laboratory

Major Data Center Energy Users



- Typical stand alone facility ~ 1MW, can be > 20 MW
- IT equipment is ~30-50% of total load; cooling is most of remainder

Why All the Interest in Data Centers?



- Critical national and global infrastructure
 - Surging demand for data processing and storage
- Rising energy intensity leads to higher cost of delivering information services
 - Power and cooling limits in existing facilities
 - Driving data center building boom
 - Cost of electricity and supporting infrastructure now surpasses capital cost of IT equipment
- Potential impact on regional power grids
- In response, Congress directed EPA to study the issue

EPA Report Findings

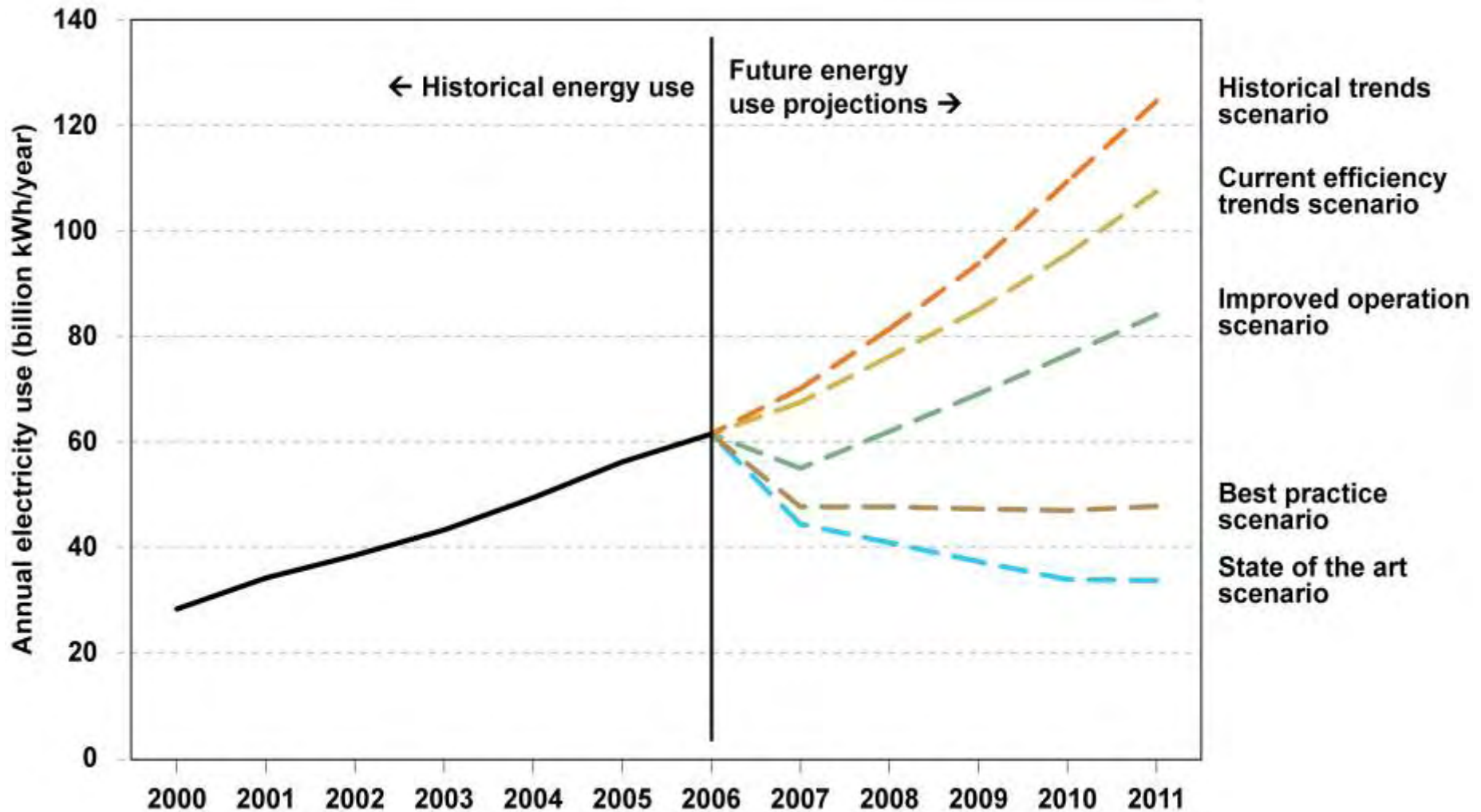


Trends in Data Center Energy Use

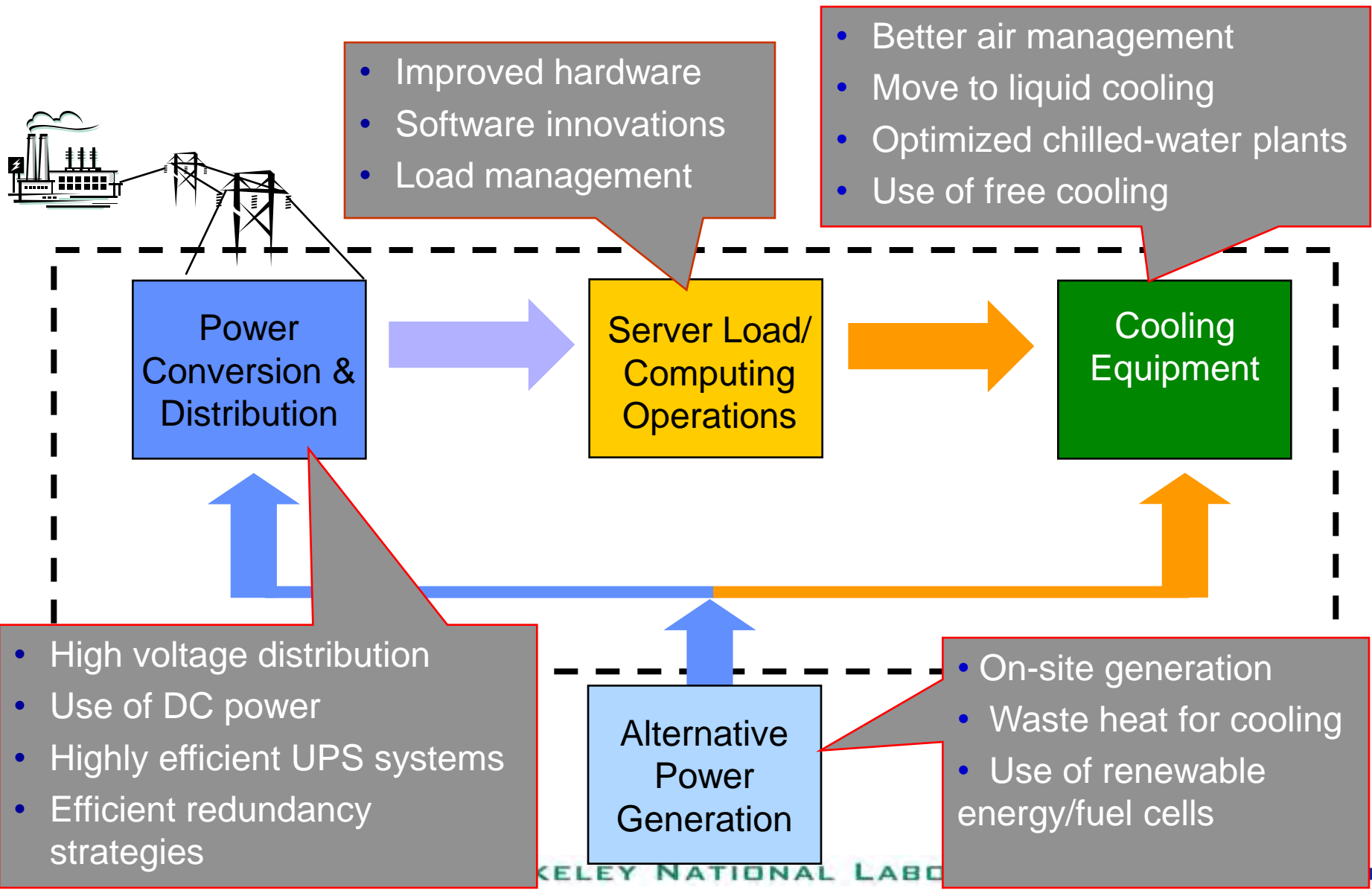
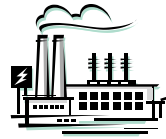
- Sector consumed about **61 billion kWh** in 2006
 - Equates to **~1.5%** total U.S. electricity consumption and **~\$4.5 billion**
 - Federal sector: ~6 billion kWh and ~\$450 million
- Projected to increase to **100 billion kWh** in 2011
 - Equates to **~2.5%** of total U.S. electricity consumption and **~\$7.4 billion**

Comparison of Projected Electricity Use

All Scenarios 2007 - 2011



Energy Efficiency Opportunities Are Everywhere



Key Barriers to Energy Efficiency



- Lack of efficiency definitions for equipment and data centers
 - Service output difficult to measure, varies among applications
 - Need for metrics and more data: *How do we account for computing performance?*
- Split incentives
 - Disconnect between IT and facilities managers
- Risk aversion
 - Fear of change and potential downtime – energy efficiency perceived as a change with uncertain value and risk

Report Recommendations



- Standardized performance measurements for IT equipment and data centers
 - Development of benchmark/metric for data centers
 - ENERGY STAR label for servers, storage and network equipment
- Leadership by federal government
 - Publicly report energy performance of datacenters
 - Conduct energy efficiency assessments in all datacenters in 2-3 years
 - Architect of the Capital, implement server-related recommendations in Greening of the Capital report

Recommendations, con't.



- Private Sector Challenge
 - CEOs commit to conduct energy efficiency assessments, implement measures, and report performance
- Information on Best Practices
 - Raise awareness and reduce perceived risk of energy efficiency improvements in datacenter
 - Government partner with private industry: case studies, best practices
- Research and Development
 - Develop technologies and practices for data center energy efficiency (e.g., hardware, software, power conversion)

Industry Action: Climate Savers



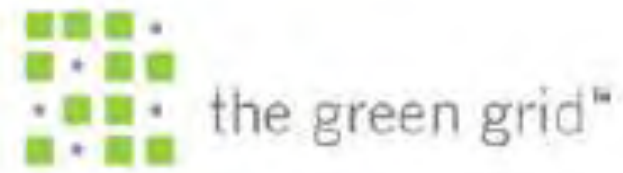
- Global non-profit consortium (formed by Intel and Google) of industry, business, universities, conservation groups, governments, consumers
- Goals:
 - Accelerate production/distribution of energy efficient computers
 - Increase use of power management tools
- Desired Results:
 - Reduce the computing industry's carbon footprint
 - Lower TCO for computer users
 - Make high efficiency the norm for the industry
- Web site: www.climatesaverscomputing.org



Industry Action: Green Grid



- Global consortium dedicated to developing and promoting energy efficiency for data centers by:
 - Defining meaningful, user-centric models and metrics
 - Developing standards, measurement methods, best practices and technologies to improve performance against the defined metrics
 - Promoting the adoption of energy efficient standards, processes, measurements and technologies
- Membership includes equipment vendors, data center designers and operators, and utilities
- DOE and Green Grid have signed MOU for cooperation



What's the Government's Role?



- Federal agencies (EPA & DOE) can be catalyst
 - Stimulate competition on energy efficiency
 - Foster discussions between key stakeholders
 - Provide key recommendations (e.g., EPA Report to Congress)
 - Developing standardized test procedures and metrics to measure energy consumption (e.g., ENERGY STAR)
- Take the lead on best practices and metering of federal datacenters
- Promote initiatives globally (Canada, EU, UK, China, India, Australia)

ENERGY STAR Specification for Servers

- Server energy demand **drives DC power & cooling needs**
- Goal: Create protocol to measure server energy efficiency to allow fair competition
- Tier 1 technical specification would have several key elements:
 - Definitions of product types eligible for ENERGY STAR
 - Test procedure for energy efficiency
 - Power Supply Efficiency and Power Factor (like 80 Plus)
 - Standardized Performance Labeling and Reporting
 - Active Power Management
 - Networking, Benchmarking, and Other Considerations
- Longer term (i.e. Tier 2, replacing Tier 1) would be a more holistic metric (system efficiency)
- Goal – Tier 1 specification finalized by early 2008

EPA ENERGY STAR for Commercial Buildings – Data Centers

- ENERGY STAR has existing partnerships with large end-users
 - Banking, financial services, insurance, internet commerce
- Partners operate stand alone data centers and data centers in larger office buildings
- Energy use in data centers is increasingly important to Partners
- Goals
 - Develop rating for stand alone data centers (**How** is my data center performing?)
 - Incorporate data centers into building ratings
- Activities
 - Agreement on consensus metrics
 - Monitored data on energy use in data centers
 - Develop energy performance benchmark using monitored data
 - Design metrics that can handle change



DOE (Save Energy Now)

- Develop Software Tool Suite with energy assessment protocols (**Why** is my data center performing the way it is?)
- Create consensus metrics for data center energy efficiency
- Create a “standard” for a state-of-the-art data center, including a strategy for incorporating distributed generation technologies
- Create and publicize case studies through performing pilot energy assessments
- Create best practice information and a training curriculum
- Develop Qualified Specialists program for Data Centers
- Conduct energy efficiency demonstrations at federal facilities using Save Energy Now strategy; assessments, tools, protocols, technologies



Actions Utilities Can Take



- Implement best practices in your own data centers
 - Automated metering is driving data center growth
- Use Climate Savers Computing and ENERGY STAR for IT procurement
- Participate in efforts (by ENERGY STAR, DOE, Green Grid) to develop metrics and efficiency specifications
 - CEE server and data center committee
- Offer incentives for individual efficiency measures (servers, virtualization, liquid cooling, etc.)
- Include data centers in whole-facility commercial building program
- Develop whole-facility program targeted at large, stand-alone facilities (possibly as part of a high-tech facility program, including laboratories and clean rooms)



Track progress at:

- www.energystar.gov/datacenters
- hightech.lbl.gov/datacenters.html
- www.eere.doe.gov/

Contact Information



- Andrew Fanara (EPA ENERGY STAR Products)
fanara.andrew@epa.gov

Rebecca Duff, ICF Consulting rduff@icfi.com
Arthur Howard, ICF Consulting ahoward@icfi.com
- Alexandra Sullivan (EPA ENERGY STAR Buildings)
sullivan.alexandra@epa.gov
Brian Carroll bcarroll@icfi.com
- Paul Scheihing (Dept. of Energy)
paul.scheihing@ee.doe.gov
- Rich Brown (LBNL)
REBrown@lbl.gov